The Cary Arboretum

of The New York Botanical Garden

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Twenty Months Under the Sun

Since "Sun-Day" – May 3, 1978, thousands of visitors have come to the Cary Arboretum's solar heated Plant Science Building to see, experience, and learn about this progressive yet fundamental style of alternative energy. Students, engineers, teachers, and guests from as far away as Russia and China have been impressed with the building's astonishing vital statistics, and have envied the quality of the spaces and work environments within. For all, the building is an inspiration, and serves as a uniquely relevant teaching tool.

"Solar energy," visitors may be told by a tour guide, "is the most pervasive and accessible energy form on earth. It is the energy trapped by plants during photosynthesis, it has been stored from these sources by geological happenstance in coal and petroleum, it evaporates water which falls as rain to drive waterwheels inserted as impediments to stream flow, it warms air to create winds that push windmill blades, and it literally warms every light absorbing object struck by sunbeams, including stones, lakes, leaves, skin, and the earth itself."

The Plant Science Building is designed to capitalize on the favorable, warming effects of sunlight, and to minimize heat loss after it is captured and delivered to the building's interior. The structure as a whole is nestled against an evergreen forest and sheltered by a range of hills that diminish the velocity of winds that can carry heat away from exposed surfaces. The entire surface of the building is wrapped in a cocoon of thick styrofoam to provide excellent insulation. This is reinforced by buffering vestibules for all entrances, and by insulating, weatherstripped panels that can be manually set to cover all windows and skylights at night or during periods of extreme cold.

The ultimate in year-round insulation is provided by sinking all of the lower story and much of the upper story into the earth itself. Below the soil level that fluctuates in temperature with seasonal changes (the uppermost three or four feet), the earth maintains a consistant temperature of approximately 50°F throughout the year. Thus, in winter, one needs only to boost the interior temperature a few degrees to make it liveable. In summer, cooling the upper, more exposed level is quite easy, and, in fact, requires no artificial refrigeration which demands fossil fuel use.

Superb insulation is backed up by incorporating great quantities of "thermal mass" into the building. This is no more than thick walls and floors of concrete that serve as heat sinks. In the winter, once heated, these release heat into the cooling air, and greatly slow the cooling process. In summer, when cool, they absorb large quantities of heat, thereby slowing the warming process.

The combination of enormous thermal mass and extraordinary insulation results in a building that neither cools nor warms rapidly, and the energy required to maintain a comfortable equilibrium between the temperature within the building and without is minimal. Through combination of these factors, it is possible to heat the building, when exterior extremes extend to zero degrees Fahrenheit and a ten mile per hour wind, with water of only 103°F.

The low temperature heating requirement permits effective solar collecting even on bright, cloudy days, and over a long period on brighter, sunny days throughout the winter. When high collecting temperatures are not possible, low levels of heat can be stored in a large (14,000 gallon) storage tank to provide warmth that can be extracted and concentrated by an energy-efficient heat pump. Because a heat pump merely concentrates heat that already exists in warm heated water, or in well water heated by the rock strata of the earth itself, it is much more efficient than a furnace that must create the heat by burning oil or other fuel.

Solar heat energy is captured by seven rows of 191 solar panels, presenting approximately 5,650 square feet of surface to the sun at an angle of 60°. Two types of collectors are used on the building, with provisions to eventually monitor the performance of each type separately. There are operational reasons for using two collector designs, but the data collected also will make an

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Seven rows of panels representing 191 solar collectors face the sun at an angle of 60°

Annual Appeal Underway

Mrs. Harding F. Bancroft of Millbrook has led the Arboretum's second annual appeal by submitting letters to members and close friends of the Arboretum.

"In its brief history," she says, "the Cary Arboretum is becoming a major cultural institution in our community . . . supported entirely from gifts and grants."

Donations for education, research, horticulture and special projects are being gratefully received. According to Arboretum Director, Dr. Willard Payne, "One of the most important and exciting attributes of this funding is that the money can be channelled directly into support of special programs. A dollar sent to support a project can be used entirely for that project and the result is direct, immediate enhancement of the Arboretum's abilities to serve science and society."

Twenty Months Under the Sun

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important scientific contribution in this rapidly developing area of applied ecological engineering.

The four southernmost rows are made of three-foot by seven-foot sections of flat plate collectors, consisting of two layers of tempered glass cover-plates above black steel absorber plates. The three northerly rows operate on a different principal. The fluid flows through horizontal copper tubing (etched black) which in turn is insulated within two encasing glass tubes. A silver coating on the backside of the inner surface of the larger glass tube acts as a reflector, focusing and concentrating heat in the copper tube before it flows to the heat exchangers.

The Plant Science Building was designed to require only 43,000 BTU's (British Thermal Units) per square foot a year to heat and cool beyond the contribution of the solar system. This is in comparison to approximately 200,000 BTU's per square foot per year to heat and cool a conventional building. It was anticipated in the design phases that 85% of all heating needs would be provided by the solar system. It was expected that other energy requirements for cooling and lighting would be minimized by basic design features. In every way, the building is surpassing design expectations.

During the year May 1, 1978, through April 30, 1979, the total energy requirement for all functions – heating, cooling, lighting, and operation of all equipment – including refrigerators, growth chambers, solar-assisted water heaters, and such specialized equipment as autoclaves and walk-in coolers, was only 19,000 BTU's per square foot, a far cry from 43,000 BTU's for heating alone! During the year, no other fuel, gas, coal, oil, or wood, was used at all. During this period, the total energy cost of the building was only about one-tenth that of conventional buildings, a savings that will increase, and will become even more significant for the operations budget in years to come.

In all, the 30,228 square feet of building

28 skylights keep the office and lab areas brightly lit and are closed at night to help insulate the building.

area has cost $2,355,000, not including landscaping and other site development. This is less than $78 per square foot, including the solar system, backup heat pump, and all built-in furniture, such as fixed desks, file cabinets, bookshelves, laboratory benches, carpeting, a room-size cooler, and window and skylight panels. This compares to an approximate construction cost of $100 to $150 per square foot for buildings of comparable purpose and conventional design and architecture. Thus, although it is frequently claimed that effective solar construction is prohibitively expensive, this was not the case with the Plant Science Building. Beyond this initial savings, the total energy expenses averaged less than one-tenth of a conventional building, and these costs will rise less rapidly than those tied to conventional heating and illumination.

Thus, with no additional cost for solar equipment or construction, the building presently requires about $1,240 less per month than conventional units of similar function and size. If one factors into this the savings in insurance costs and escalating energy rates certain in the future, the economic differentials are surprisingly favorable.

The basic savings mentioned are only the background against which the Arboretum is exploring other topics of significance in the search for energy alternatives. Some of these extras include solar heated water, skylights, timed light switches, vinyl and fiberglass window shutters, and styrofoam insulation, which have been topics of courses, slide presentations, and pamphlets distributed as useful information to homeowners. Forty concerned energy-savers participated recently in an insulated shutter construction and installation workshop offered through the Arboretum's Education Department. Participants in the course learned that conventional storm windows and thermopane glazing only provide an R-value (resistance to heat loss value) of 2, losing six times as much heat as the insulated walls of a conventional, well-insulated home. Panels similar to those used in the Plant Science Building easily constructed in the class or at home, save both fuel and dollars.

The Plant Science Building is proving to be both an ideal work and study environment, and an extraordinary teaching tool for the public. Hailed locally in the pre-OPEC era of 1972 as a probably expensive and barely relevant experiment in ecological sensitivity, it is now proving to be a pacesetting economical innovation. Relatively inexpensive to build and implement, and astonishingly inexpensive to heat and maintain, it is a facility of great fascination and complete relevance to the present-day situation anticipated by Garden scientists nearly a decade ago. When fully equipped for experimental research and education in solar technology, it will continue to play significant roles in our search for environmentally and economically sound alternatives to fossil fuel dependence.

Energy Saving Plants

by Paul Mihan, Plant Propagator

The issue of greatest national interest at this time is saving energy, or finding energy alternatives. Although no house plant will provide one with gasoline or fuel oil, there are many that are happy living in cooler homes.

The major key to success with all house plants is to first determine what types of environments your home has to offer and then to select the types of plants that grow best in those environments.

The following is a listing of plants that are recommended for the very cool home (60°F.) with a minimum of direct sunlight. Keep in mind that the 60° figure is an average, and remember that the critical temperature for plants is the night or coldest temperature. This selection of very durable house plants is excellent for the beginning gardener – even those with homes where temperatures and light may seem inadequate for most decorative plants.

Species of the *Aglaonema* genus are erect plants suitable for the table in small or large pots. They grow well in low-light situations and are able to withstand shade for very long periods of time.

Members of the *Aspidistra* genus are very similar in appearance to spathiphyllum plants, but have larger, tougher, more leathery leaves. They are known as "Cast Iron Plants" because they are so durable. They do not like direct sun and seem to thrive on neglect. They make good floor plants in large pots or tubs.

The Norfolk Island Pine *(Araucaria excelsa)* is a very durable plant which is hardy in southern areas of the United States. In the north, it makes a good house plant and does not require full sun, but will need good indirect light.

Dracaena species make excellent pot or table plants. They are very hardy in dry, indoor environments, and are particularly suitable for homes heated with forced hot air.

Ficus, or ornamental figs, are also very tough house plants. They can withstand chilling almost to freezing, and will grow in either sun or shade. They make good table plants and eventually take on a bush or tree like form to make great tub or floor plants. (I have a six-foot tall *Ficus benjamina* in my living room that I decorate with balloons on my children's birthdays.)

Sansevieria, or snake plants, do not remotely resemble snakes, although some varieties have scale-like leaf spots resembling patterns found on snakes. They were named for the Prince of Sanseviero and grow naturally in Africa and the East Indies where native people use them as hemp for making very strong cordage, for instance to string hunting bows. Most types of *Sansevierias* are erect, make good table plants, and can grow with very little light.

Dieffenbachia, or dumb cane plants come from the rain forests of Central and South America. They do not need direct sunlight, and do not like to be chilled below 55°F. *Dieffenbachias* make good table plants, and may be grouped together for a more bushy effect. In time, they also become tall and tree-like. The common name, dumb cane, is derived from the fact that crystals in the

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Energy Saving Plants

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plant's tissues can penetrate and paralyze the vocal cords, rendering the person dumb. In rare instances, swelling of the throat tissues can completely cut off the supply of air and cause death by asphyxiation. Therefore, this very popular house plant should be carefully maintained out of baby's reach.

Most palms are generally thought of as tub or floor plants, but small palms also make excellent table plants, and they do not grow very quickly. *Howeria kentia var. fosteriana* – the Paradise Palm – is an attractive palm that can reach a height of six feet over a period of several years.

For those growers that have uncovered windows with ample light but who also keep their homes cool, there are additional plants that will grow well and provide flower color throughout the winter. If, for example, you have a large bay window in a cool room, the following plants will do very nicely:

Aloe	*Crassula argentea* (Jade Plant)	*Oxalis*
Asparagus plumosus	Ferns	*Pelargonium* (Geranium)
Cacti	*Fuchsia*	*Ruscus*
Chlorophytum (Spider Plant)	*Hedera helix* (Ivy)	*Tradescantia*
	Kalanchoe	

At the Garden

The New York Botanical Garden's Enid A. Haupt Conservatory in the Bronx is a refreshing green oasis this season for those who would like to escape the grips of Old Man Winter.

Only 70 miles from Millbrook, the 78-year old Conservatory is open daily, 10 to 4 p.m., and is bound to stir up a touch of springtime on even the coldest of days. The beautiful indoor Christmas display, featuring thousands of poinsettias, will be replaced on Valentine's Day with the Annual Spring Show featuring azaleas, tulips and hyacinths, displayed in glorious colorful design.

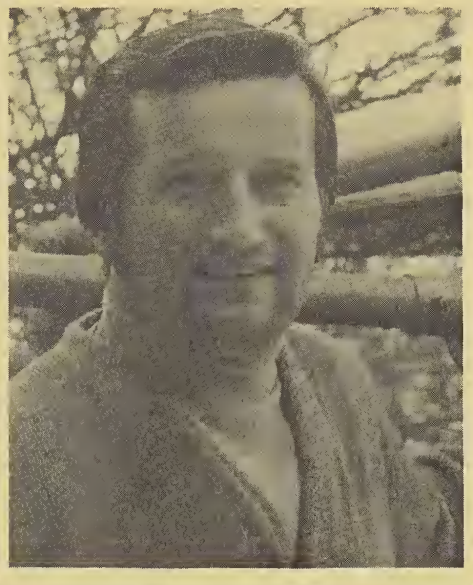
The eleven connected glass houses offer everything in the botanical world from ferns to cactus, including floating plants, hanging plants, species collected around the world, and plants that can be found in your own back yard. Children especially enjoy "Greenworld" – a botanical grocery store where they can match-up products on a shelf with the herb, grain, or tree it is derived from.

If music is your fancy, three programs remain in a series of six "Crystal Palace Concerts" where plants and glass blend to create lovely acoustics and a beautiful environment in which to enjoy classical compositions. February 17, quartet and soprano soloist Janis-Rozena Peri will perform uncommon works by Richard Strauss and Ravel. On March 16, the New York Kammermusicker will feature a program for a double-reed ensemble of Renaissance, Baroque and modern works composed for this unusual instrumentation. April 20 will bring the Bronx Arts Ensemble to the Garden. They will perform works of Mozart, Hindemith, Honegger and Rheinberger.

For more information on activities at the New York Botanical Garden, please contact Ms. Robin Parow at (914) 677-5343.

People at the Arboretum

Henry Behrens, Mason.. . . A personable man who says he was amazed at the beauty and peacefulness of the Arboretum, Henry has a diverse history, which includes working as a singing waiter in Germany and as a butcher in Rhinebeck, New York.



Henry Behrens

Raised near Hamburg, West Germany, Henry learned his trade of masonry and came to the United States when he was twenty years old. In addition to attending night school to learn the basics of the English language, he worked as a mason in Detroit and then in New York City, where contracts included projects at Lincoln Center and the Lincoln Tower Apartments on West End Avenue. "Learning to speak English was not easy", he smiles, "but I picked up a lot from the masons I worked with, who really had quite a vocabulary!"

Henry and his wife Margot moved to Rhinecliff in 1965. Their 13-year old son David is studying the German language and plans to visit two uncles in West Germany next summer.

In addition to being an experienced butcher, Henry plays the harmonica, teaches Sunday School, and is a referee for summer soccer leagues.

At Cary, not only are his masonry talents put into action, but he lends a hand in painting and carpentry as well. "There's such a friendly atmosphere here – everyone knows each other", he says, adding that life in the United States is everything he hoped it would be.

Gus Tillman Receives Go-Ahead for Development of World-Scale Irrigation Guides

Dr. Robert (Gus) Tillman, Ecologist for the Arboretum, has recently been awarded $60,000 to develop environmental guidelines for worldwide large and small scale irrigation projects.

The grant, which will include approximately 45 days of extensive field work, is provided through the U.S. AID (Agency for International Development) and the Man and Biosphere Program, (MAB) which operates under the auspices of UNESCO (United Nations Education, Scientific and Cultural Organization).

At a recent United Nations Conference on Desertification, irrigation developments were cited as critical for the future of agriculture and man's survival in much of the world's marginal lands. It was found that some past irrigation projects have actually increased human health hazards, caused groundwater depletion, decreased soil productivity through salt accumulation and waterlogging, and decreased water quality in both potable and nonpotable water supplies. However, several irrigation techniques, such as those used in the Southwestern United States, Australia, and Israel, have proven to be safe, effective models for irrigation processes. "There is little question that, with proper planning, design, and operation, irrigation projects can be successfully implemented in most arid zones to convert marginal lands into productive agricultural units," says Dr. Tillman. "Currently, information on irrigation remains widely dispersed throughout a variety of reference sources, and there is no concise document which can provide environmental guidelines." Dr. Tillman's proposal to combine information on irrigation projects will be the first of its kind, and will offer new information to countries suffering severe food shortages due to insufficient irrigation knowledge or inappropriate irrigation methods.

Dr. Tillman will conduct studies and prepare advice on irrigation techniques used in several Sahelian and East African countries. Other areas to be examined for special significance of their terrain or water and soil systems include Israel, Indonesia, Australia, and the Philippines. In our own country, the arid Southwest is extensively irrigated, and uses the most recent advances in irrigation methodology, including solar-powered pumps and central pivot irrigation. Advances in drip or trickle irrigation are also featured in this country.

Findings from this project will be published by the Cary Arboretum for UNESCO's Man and Biosphere Program to assist nations and private concerns everywhere to carry out successful and ecologically sound irrigation projects.

Test-Tube Elm Baby in the Making

According to Cary Arboretum Forest Geneticist Dr. David Karnosky, tissue culture offers new hope for successfully crossing otherwise incompatible plant species. For example, the isolation and fusion of plant protoplasts (living cells with their walls removed by enzyme treatments) has proven successful in hybridizing potato with tomato without reliance on the regular sexual process requiring eggs of one and sperms of the other.

It is no surprise, then, that an attempt is being made by Dr. Karnosky and two of his graduate students, Mr. Keith Redenbaugh and Ms. Dawn Lange, to produce disease-resistant hybrid elms using similar tissue culture techniques. The goal of the project is to obtain a hybrid elm which will have the desirable ornamental and urban-hardiness traits of the American elm *(Ulmus americana)* and the disease resistance of the Siberian elm *(Ulmus pumila)*. Support for this project has come in the form of grants from the National Parks Service and the International Paper Company Foundation.

Work to date has concentrated on testing various enzyme combinations for isolating protoplasts from different tissues of the two species, examining several growth media for culturing the protoplasts, fusing the protoplasts, and identifying the hybrid fusion products. Fusion has now been accomplished in laboratories of the New York Botanical Garden, and current work is concentrating on attempts to regenerate whole plants from the fusion products.

Photographs in This Issue
by Robin Parow

Deer Herd Control Program at Cary

Annual deer herd reduction for 1979, under the supervision of Coordinator of Wildlife Resources Jay McAninch, ended December 11 with a total of 57 deer taken.

The annual hunt, which is part of the Cary Arboretum's Wildlife Program to control the population structure and density of resident deer, was carried out by 56 hunters chosen from 86 applicants.

"By controlling the number of hunters who participate in the program, we can prescribe the number of animals to be taken", says Mr. McAninch, who has systematized the program by requiring prospective hunters to submit a detailed application, attend a pre-hunt seminar, and take a weapon proficiency test. Mr. McAninch added that most men who come to Cary for the hunt are "serious hunters who respect the land and rules." As of this year, no women have participated in the hunt. However, those interested are welcome to apply.

In addition to preliminary testing, the Wildlife Department requires hunters to check in and out of the Cary property. Carefully mapped parking areas guarantee that no more than a regulated number of hunters will be in any one part of the grounds at one time. Hunted deer are brought intact to the Wildlife Lab where a 20-minute examination provides data to evaluate the condition of the Cary deer herd.

As part of the larger study of deer biology, the annual deer hunt is an aspect of the Arboretum's central concern for forest ecology. Data acquired during the hunt help tell Arboretum scientists about deer physiology, parasites, tissue and organ conditions and reproduction. It is clear that deer throughout the Northeastern United States are entering the winter period in excellent condition this year. "When we consider the rapid deer population increase overall, and the unprecedented numbers of animals this year, we can anticipate extraordinary damage levels for agriculturists, orchardists, and homeowners throughout the region," reports Mr. McAninch. "It is to find solutions to these problems, both for the animals and for human concerns, that the Arboretum program is carried out," he concludes.

Don't Hibernate

Indoors or outdoors – choose your winter setting at the Cary Arboretum this month by registering for a course in Winter Botany or cross-country skiing.

Dr. Willard Payne, Director of the Arboretum, will instruct a one-day winter botany course which will meet on January 12, 9 a.m. to 3 p.m. at the Gifford House Education and Visitor Center on the Sharon Turnpike. Anyone baffled by the identification of unadorned, winterized trees and plants may find this course a useful tool all year long. Half the day is spent out of doors, so dress warmly.

Also at the Gifford House, Paul and Pete Relyea of the Sundance Sports, Ltd. will conduct a one-day cross-country ski clinic for beginners on Saturday, January 19, 10 a.m. to 3 p.m. A morning session will include instructions on types of equipment, waxing, new no-wax programs, techniques, clothing and safety.

Provide your own equipment or rent at a special discount at Sundance Sports for the afternoon outdoor instruction, and enjoy the Arboretum's cross-country ski trail throughout the winter.

For further information, contact Mrs. Marcia Davis at (914) 677-5358.

THE CARY ARBORETUM
of
THE NEW YORK
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